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Improving Navy's Buying Power Through Cost Savings

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14. ABSTRACT

The Department of the Navy wants to recapitalize but finds that it does not have as much buying power as it used to. Last year, CNA examined the trends in the Navy's budgets and prices to understand why the Navy could not buy as many weapons platforms as it used to: the study found that the Navy had less to spend on procurement than before and that the Navy's mix of ships and aircraft cost more on average now than before. To reverse the trend and buy more platforms, the Navy needs to devote more money for procurement and/or buy less expensive platforms. This study examined various initiatives or savings opportunities (total of 17) that would allow the Navy to allocate more money for procurement. Taken together, the total savings from these initiatives are about $7 billion to $10 billion (or 5 to 8 percent of the Navy's annual budget). We assessed the risk associated with these initiatives and deemed most to be minimal to moderate risk in terms of cost uncertainty, effects on readiness, or other effectiveness measures. Nonetheless, tough decisions must be made and cultural and other barriers must be overcome before the Navy may reap the savings.

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Contents

Summary

The Department of the Navy wants to recapitalize but finds that it does not have as much buying power as it used to. Last year, Center for Naval Analyses examined the trends in the Navy's budgets and prices to understand why the Navy could not buy as many weapons platforms as it used to. Basically, it found that the Navy had less to spend on procurement than before and that the Navy's mix of ships and aircraft cost more on average now than before. To reverse the trend and buy more platforms, the Navy needs to devote more money for procurement and/or buy less expensive platforms. This study, sponsored by the Deputy Assistant Secretary of the Navy (Management and Budget), examined various initiatives or savings opportunities that would allow the Navy to allocate more money for procurement.

Our overall approach was to compile a set of cost savings initiatives, most of which have been identified in previous studies, assess them, and project the overall savings.[1] As a part of the assessment, we examined risks associated with each of the initiatives (such as reduced readiness or retention) and factors that may hinder effective implementation of the initiatives (such as cultural and political barriers).

Table 1 summarizes the specific initiatives, along with the potential savings from their full implementation. Taken together, the total savings from these initiatives are about $7 billion to $10 billion. To put the savings figures in context, they represent 5 to 8 percent of the Navy's annual budget.

The Navy has control over implementation of all of these ideas, except reforming military retirement pays (the low end of the savings range does not include this savings). As mentioned, we assessed the

1. Center for Naval Analyses had undertaken a similar endeavor a few years ago with a comparable approach in [1].

risk associated with each of these initiatives and deemed most to be minimal to moderate risk in terms of cost uncertainty, effects on readiness, or other effectiveness measures. Nonetheless, tough decisions must be made and cultural and other barriers must be overcome before the Navy may reap the savings. In addition, individual initiatives, the savings figures, and the associated risks should be more thoroughly assessed before the Navy decides to implement changes. However, this study suggests that there are ample opportunities for savings that could contribute substantially toward improving the Navy's buying power.

Table 1. Cost-cutting initiatives

Ideas for savings	Potential annual savings
Reducing ship manning through Mil-Civ conversion of some functions	$750M
Using more experienced and specialized sailors and longer tours	$410M
Competitive sourcing	$2.5B - $4.3B
Decrewing during overhauls	$280M
Reducing shore-based pilots	$490M
Adjusting to optimal reenlistment rates	$17M - $85M
Reforming military retirement pay	Up to $780M
Applying crew rotation to cruisers and destroyers	$670M
Using changes in depot maintenance norms	$600M
Reducing supply time for AVCALs and SHORECALs	$200M
Sharing AVCALs among carriers	$10M
Managing aircraft fatigue life	$200M
Reducing flight hours early in training cycle	$300M
Savings in test and evaluation (T&E)	$80M
Reducing electricity costs	$10M
Applying lean manufacturing to Navy shipbuilding	$430M
Applying lean manufacturing to defense aircraft industry	Up to $800M
Sum	$6.9B - $10.4B

Introduction

Background

An earlier CNA study [2] examined the trends in the Navy's budgets and prices to understand why the Navy could not buy as many platforms as it used to. One of the findings was that the Navy had $4 billion (or 12 percent) less to spend on procurement in FY 2006 than the 30-year average. The reasons for the lower procurement level included: lower than average Navy topline, historical high spending in Research and Development (RDT&E), and Military Personnel and Operations and Maintenance accounts that had not come down as much as endstrength and force size (number of ships and aircraft). CNA is currently examining the longer-term (60 years) trends for the major appropriations within the Navy budget and inferences for the future.[2]

This relatively low level of procurement, coupled with CNO Mullen's long-term shipbuilding plan that calls for the development of 313-ship Navy over the next 30 years, require analysis of potential savings from the Navy's nonprocurement accounts that could be used for the recapitalization goal. The Secretary of the Navy "speculated that the Navy could find excesses in operations and maintenance, personnel accounts and other aspects of the Navy budget."[3]

2. This study to be completed early 2007, is examining issues such as: Will the Navy's projected budget allow buying and sustaining a 313-ship battle force?

3. "Winter, Mullen Discuss Ways to Achieve Long-Term Shipbuilding Plan," *Inside the Navy*, 19 Jun 2006.

Sponsor and objective

This study, tasked by the Deputy Assistant Secretary of the Navy (Management and Budget), analyzes ways to improve the Navy's buying power by examining various cost savings initiatives. Studies such as the one by the Congressional Budget Office suggest the Navy's budget is inadequate for its shipbuilding plan.[4] This study does not explicitly address the affordability issue, but it does suggest ways to make the shipbuilding plan more achievable.

Our approach

Three ways to improve the Navy's buying power are: (1) obtaining higher topline and putting more money into procurement, (2) shifting money from nonprocurement accounts to procurement, and (3) making greater use of every dollar in procurement. This study focuses on the second means of achieving greater buying power.

Our overall approach was to compile a set of cost savings initiatives, most of which had been identified in previous studies, assess them, and project the overall savings. As a part of the assessment, we examine risks associated with each of the initiatives (such as reduced readiness or retention) and factors that may hinder effective implementation of the initiatives (such as cultural and political barriers).

Organization of the paper

This paper discusses cost-saving strategies and initiatives for various aspects of the Navy budget, in the following order:

- Manning issues, including civilianization of part of ship manning, competitive sourcing, and partially decrewing Navy surface ships during long-term overhauls. We also discuss

4. A recent Congressional Budget Office study [3] states that the "Navy estimates that procuring those new ships would cost about $14.4 billion a year, whereas CBO estimates that they would cost an average of about $19.5 billion annually".

personnel compensation issues, including pay, incentives, and retirement benefits.

- Ship use and maintenance changes.
- Initiatives associated with aircraft usage and support.
- Test and Evaluation (T&E).
- Reductions in electricity costs.
- Best practices and lean manufacturing and their application to Navy shipbuilding and the defense aircraft industry could generate savings.
- The 2005 Base Realignment and Closure (BRAC), an initiative for which most of the savings may already have been earmarked.

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Manning issues

For FY 2006 the Department of the Navy (DON) anticipates having endstrength of 353,000 active duty Navy personnel and 175,000 active duty Marines. The Department also expects an endstrength of about 192,500 civilian full-time equivalents (FTEs) [4,5].[5] Military personnel, Navy (MPN) and military personnel, Marine Corps (MPMC) estimated costs for FY 2006 are $24.8 billion and $10.4 billion, respectively. The total payroll costs for the civilian employees account for an estimated $15.6 billion[6] in FY 2006. Direct personnel compensation costs,[7] therefore, account for around $50 billion, or 38 percent of the Navy's total obligational authority of $132.5 billion for FY 2006.

The potential savings from personnel initiatives presented here total $3.7 – $6.7 billion annually, which represents approximately 7–13 percent savings.

Civilianization

Military-civilian hybrid crews

Recent literature highlights substantial savings that may be realized from civilianizing parts of ship manning. In [6] the authors estimate that partially civilianizing the USS *Mount Whitney* (LCC-20) command

5. According to [5], approximately 164,300 of these civilians are Navy, 18,300 are Marine Corps, and 9,900 are departmental.

6. We estimate this as total Department of Navy civilian FTEs (192,500) multiplied by the DOD average pay per civilian FTE in FY 2006 ($81,000).

7. The MPN and MPMC figures reported here contain some items that are not direct compensation, such as the social security tax paid by the Navy and personnel change of station (PCS) costs. Also, the appropriations contain the accrual value of retirement and retiree health care benefits.

ship using Military Sealift Command (MSC) civilian mariners saves about $45 million per year.

The study estimates that adapting this hybrid manning model to civilian-man basic supply, food service, and ship's service (store, barbers, and laundry) on all surface combatants could save $750 million annually and reduce Navy endstrength by about 21,700. Reference [7] estimates that turning over ship's services to MSC would save approximately $30 million per year per command ship (four in total). This was similar in flavor to the actual manning plan adopted on the USS *Mount Whitney*. The savings in this paper are echoed by another CNA study [8] that identifies prospective savings of $23 million to $31 million per carrier per year, or $390 million per year Navy-wide, through smaller, partially civilianized crews.

Applying civilian practices to military crews

As an alternative to replacing military manpower with civilian manpower on ships, another study suggested adopting some of the manning practices used by MSC, but with military crews. The savings identified in [9] would stem from having fewer, but more experienced and specially-trained, officers and sailors. Adopting a two-track career path for officers—operations and engineering—is likely to result in better engineering management using fewer personnel.

Increasing tour lengths/reducing turnover

Reference [10] estimates that a 10 percent reduction in turnover would allow getting the same readiness with 1.43 percent fewer personnel. Civilian ship manning practices typically involve longer tours and lower turnover than current Navy practice, suggesting potential savings. In [9] the authors estimate that a 10 percent reduction in turnover carried through to all surface ships would imply annual savings of $152 million.

Reducing time sailors assigned to jobs outside of their training

Reference [9] also estimates that the practice of assigning technically trained sailors to menial jobs for the first few months on board costs the Navy $30 million annually in loss of skills. In addition, the Navy tends to provide more narrow training to sailors, which reduces

average training time but increases the number of personnel required on ship.

Adopting more flexible force-shaping tools

Reference [9] also provides an estimate for one officer community of the cost of the closed-loop military manpower system. As of December 2004, the Navy carried 1,125 junior Surface Warfare Officers in excess of requirements (at an estimated cost of $150 million) in preparation for future, more senior billets. Reference [8] surveyed 115 combatants and found 1,634 overmanned enlisted billets at a cost of $80 million per year. Reference [8] notes that one way to reduce these costs would be to move away from the pyramid-shaped workforce profile toward an oval-shaped one using lateral entry. The study also notes that "smart ship" and the optimal manning experiment have reduced some of the watchstanding requirements on USN ships, but more can be done.

Potential risks

Reference [9] discusses at length various performance metrics of MSC-manned ships and Navy equivalents. The data show that for all the metrics measured, the smaller MSC crews perform as well as or better than the Navy crews. This suggests there is likely to be minimal risk to mission performance associated with either civilian manning or adopting civilian manning practices. The USS *Mount Whitney* has not encountered problems or has found a way to deal with problems that arise when a sizeable fraction of the crew is civilian. Also, if applied to all surface combatants, hybrid manning would require MSC to increase its manning four-fold, from approximately 4,000 to over 17,000. Reference [9] suggests a phased approach to implementation. Finally, adopting civilian manning practices would require introducing new force management tools to help move toward an oval force structure. Longer tours may reduce retention, but that may be countered by the benefits of sailors avoiding mess duty upon initial arrival to the ship.

Table 2. Civilian manning or practices: savings, description, and risks

Annual Savings[a]	Description	Risks
$750 million	Substantial ship manning reduction by converting galley, basic supply and ship's service to civilian manning	Minimal: Needs to be phased in to allow MSC to ramp up
$410 million	Ship (and implied shore) manning reductions from better assignment of skilled sailors, using more experienced and specialized sailors/officers and longer tours.	Moderate: Longer tours may affect retention; transition to oval vs. pyramid inventory requires additional force management tools/policy changes

a. Note that the $750 million savings from civilianizing by definition would include a large part of the $410 million potential savings from adopting civilian practices only. To be conservative, we assume a maximum savings of $750 million from this set of initiatives, although slightly more may be possible if civilian practices are applied to the remaining military portion of the hybrid crews.

Competitive sourcing

To conduct a current assessment of the potential savings available from competitive sourcing, we consulted DON's most recent (2005) Inherently Governmental and Commercial Activities (IGCA) inventory. This database revealed 73,176 positions which DON has coded as "R - Subject to Review for Competition Under OMB Circular No. A-76," of which 27,273 are nonoperational active-duty military. This represents the most conservative count of the positions that can be competed through A-76, and is the basis for the low end of our estimated potential savings range.

The top of the savings range estimate reflects a less restrictive approach to coding and assumes that, in the long run, authorizations could be made available for competition if policy, procedural, or cultural changes were put in place. The types of changes required are significant and include, for example, lengthening time at sea to reduce authorizations for sea-shore rotation.[8] It is unlikely that the

8. Reference [11] addresses the potential constraint on the degree of outsourcing posed by the Navy's sea-shore rotation policy. A sea-shore policy of 4:3 implies that only 17–24 percent of shore billets would be available for outsourcing.

top range could ever be reached; it reflects only an upper bound determined simply by adding all of the potential savings. The authorizations included in the top range estimate are classified under the following criteria codes:

Table 3. Position codes included in the high estimate of savings

Criteria code	Criteria description	Number of authorizations
P	Pending Restructuring of Commercial Activities	19,718
R	Subject to Review for Competition Under OMB Circular No. A-76	73,176
X	Alternatives to OMB Circular No. A-76	6,644
H	Exemption for Continuity of Infrastructure Operations	11,658
J	Exemption for Civilian & Military Rotation	15,906

The following describes the methodology, assumptions, and caveats of the savings analysis.

The IGCA Inventory was used to isolate DON authorizations available for competition. Both military and civilian authorizations were included, as were direct and indirect hire foreign nationals. Individual's Account authorizations (e.g., prisoners, students, etc.) and Reserve authorizations were excluded. All authorizations providing depot maintenance activities to the DON were excluded, as legislative change would be necessary to run standard competitions in this area.

In order to reach an estimate for the cost of a civilian employee (potentially to be competed under A-76) the DOD Commercial Activities Management Information System (CAMIS) was used. In this database, 2,598 DOD-wide, standard, completed competitions were identified. These approximately 2,600 competitions were announced between 1977 and 2003 and covered about 146,000 authorizations (civilian and military). For each of these competitions we have information on size (FTE) and total in-house costs (cost of the in-house most-efficient organization (MEO)).

Assuming that a) the composition of the MEOs are a reasonable proxy for the composition of the DON workforce available for competition, and b) that the overwhelming majority of MEO costs are personnel costs and benefits, a cost per civilian FTE can be estimated. By annualizing total MEO costs and dividing by size of MEO, a cost per FTE is developed for each specific competition. Median cost per FTE was about $99,980 (in 2006 dollars).[9]

Another estimate of average civilian cost can be obtained by calculating average civilian payroll for DOD in FY 2005 (approximately $81,000) and escalating by the Office of the Secretary of Defense (OSD) Comptroller's fringe benefits multiplier for the Navy of 29.5 percent. This yields an estimated cost per civilian of $104,900. To be conservative, we use the lower cost estimate ($99,980) in the savings figures reported here.

In order to estimate a savings rate, the CAMIS data was used again. For each completed DON competition the expected savings was calculated as compared to baseline. A weighted average was taken based on size (FTE) of competition. The expected savings rate was calculated at 34 percent. This rate is based on the population of DON competitions announced between 1977 and 2003. Long run trend analysis show this rate steadily increasing, therefore the 34 percent savings rate can be viewed as conservative.

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9. There are a few caveats to bear in mind when using estimates of civilian costs based on CAMIS data. 1) The total in-house cost estimate includes benefits, i.e., it is designed to be fully burdened cost. 2) There are other costs beyond personnel in the in-house cost estimate. While these have traditionally been small, they are not insignificant and do artificially inflate the $99,980 estimate. 3) The data covers 1977 to 2003. Most of the earlier competitions covered traditional "blue collar" activities (e.g., facility maintenance, vehicle operation, etc.). While this type of competition still occurs, the trend in recent years has been toward more pink or white collar activities (e.g., IT, accounting, human resources, etc.) which have higher pay grades as compared to the traditional blue collar activities. So, the $99,980 estimate in this case may be conservative given the expectation that competitions will involve higher paid positions in the future. Given all these caveats, the $99,980 estimate is probably fairly accurate.

Once the number of authorizations, savings rate, and cost of a civilian were isolated, we estimated a range of cost savings. This calculation is shown in table 4.

Table 4. Competitive sourcing potential savings calculation (FY06 dollars)

IGCA category code	Authorizations	Exp savings	FTE saved	Cost per FTE	Total savings
Just R	73,176	0.34	24,880	$99,980	$2,487,486,403
R, P, X, H, J	127,102	0.34	43,215	$99,980	$4,320,603,706

One important issue to bear in mind is that conducting competitions for the total numbers of positions shown above (73,176 or 127,102) would require many years. To put this in some context, the current Navy goal is to compete 29,000 billets between FY 2006 and FY 2010.

Past CNA research [12, 13] has also forecast potential savings in excess of $2 billion.

Function-specific estimates

Additionally, several specific functions have been studied for the purpose of estimating the potential savings from competitive sourcing or military-civilian substitution. For example, [14] calculated savings in training costs of $5 million per year for a group of eight selected Navy Enlisted Classifications (NECs).

Reference [15] shows that if in-house training savings are included, the Navy could save $100 million per year by converting 5,415 medical billets to civilian.

Reference [16] found that outsourcing land-based search and rescue operations could save about $20 million annually.

Reference [17] suggests that the Navy may want to have fewer medical residents, but more contractor physicians to pick up slack. Such an initiative could save $34 million to $250 million per year, depending on relative productivity assumptions.

Reference [18] calculates that, holding endstrength constant, DOD can save $20 million annually by offering bonuses to hire private-sector trained medical specialists in shortage. The source of savings is lower in-house training costs stemming from the reduction in medical personnel from specialties that are in surplus (those in which inventory exceeds requirements).

Reference [19] compares costs for three enlisted active duty courses taught in-house vs. in community colleges. For the courses examined, it found that the community colleges costs were one-sixth those of the Navy.

Table 5. Competitive sourcing: savings, description, and risks

Annual savings	Description	Risks
$2.5 – 4.3 billion	Expected 34 percent personnel savings from positions available for competition	Minimal for low end of estimate, high for top end: Estimate is based on historical savings rates, which have been increasing. Realizing high-end savings requires some changes to military rotation and assignment policies.

Decrewing

We examined the possible savings that might accrue if Navy surface ships undergoing long-term overhauls or depot maintenance periods were partially decrewed during the shipyard period. We look only at those depot maintenance availabilities for surface ships that exceed 7 months in duration. But we base our estimates on actual yard periods, not the representative durations used in planning maintenance availabilities. Our estimates do not consider entirely decrewed ships. Instead, recognizing that more experienced petty officers are needed to accomplish vital repair work such as the overhaul and repair of valves, and that some juniors are necessary for the fire-watch function,[10] we assume a proportion of the crew is assigned throughout the

10. A fire-watch is a safety function assigned when a shipyard welder is working, in which another person has the duty of looking for the outbreak of a fire on the other side of the bulkhead.

overhaul. However, that proportion retained is not sufficient to perform the typical less desirable maintenance jobs in the ship force work package, and work planning must be adjusted accordingly. Also, the skeleton crew retained is not sized to perform a variety of services for the crew such as food preparation and food service functions, compartment cleaning and head cleaning functions, or typical quasi-security functions such as parking lot security patrols.

Findings

We estimate that annual saving of as much as $295.9 million in FY 2008 values is possible by adapting a new policy to partially decrew surface ships of the Navy in long-term overhauls. We have included Docking Planned Incremental Availabilities (DPIAs) for CVNs that are typically about 10.5 months long, but not the shorter non-docking PIA events that are usually less than 7 months long. We have also included the Refueling Complex Overhaul (RCOH) for the CVN which typically is planned for 36 months duration but is often up to 10 months longer. Though we consider this event for only partial decrewing in these calculations, it might be worth considering returning to an earlier policy were CVs were decommissioned when in extended overhaul periods. The only other classes considered are amphibious assault ships and surface combatants in long-term maintenance availabilities. Submarine overhauls are not included in this assessment.

Methodology

We reviewed the last 5 years of depot maintenance events as reported in the summaries of the daily OPREP-3 reports made by each ship and documented in the "Ship Employment Histories," resident at CNA. We excluded all events that did not exceed 7 months in duration. We then examined the personnel and billet files that record all personnel transactions in each ship of the Navy. These files are also resident at CNA. For those ships in long-term overhaul we looked at the actual billet fills for five periods associated with each overhaul. We established the manning level by pay grade for a point (1) 3 months prior to the overhaul, (2) at the beginning of the overhaul, (3) 3 months into the overhaul, (4) at the end of the overhaul, and (5) 3 months

after the date of completion of the overhaul. We were surprised by the large number of E-1 and E-2 personnel in each of these crews.

We then took the Composite Standard Rate of each pay grade's compensation as direct costs and indirect MPN and O&M,N associated with each paygrade, in the "True Cost of a Sailor" methodology as developed by the Center for Cost Analysis. We used values for FY 2003 and escalated to FY 2008.

We reduced each established crew by the proportion shown in table 6.

Table 6. Proportion of crew reduction

Pay grade	Percent reduced	Percent retained
E-1 to E-3	90	10
E-4 to E-6	60	40
E-7	30	70
E-8	20	80
E-9	10	90

Table 7 illustrates the affect of such a crew reduction on the most recently completed CVN RCOH, for the USS *Eisenhower* (CVN-69) that began in August 2001 and ran for 46 months. As can be seen following the concept in this proposal, the ship would have kept 32 percent of the entire reduced crew that it did have in the RCOH. Certainly that should be sufficient to meet nuclear regulatory requirements and man the entire Reactor and Engineering departments, if necessary. Also, 880 people is more than enough to create a significant number of in-port duty fire parties. If split to ten sections there would still be 88 people in each duty section, and each duty section would be supervisor-intensive and almost completely composed of experienced people.

In our costing we assume that the manning should be reduced immediately upon entering the yard, if not before, and that re-manning the various pay grades to the levels that were actually attained in the overhauls should begin about 3 months prior to the end of the overhauls.

Table 7. Illustrative proportion of crew reduction. USS *Eisenhower* RCOH

Pay grade	Number in crew	Number retained
E-1 to E-3	721	72
E-4 to E-6	1,843	737
E-7	132	39
E-8	37	12
E-9	22	20
Total	2,755	880

Accomplishment of the ship force work package

In an earlier report [20] in 1999, we were provided estimates of up to $226,000 per man year to contract out the tile work done by junior Navy sailors in the ship's force work package. At that time we rejoined with the observation that "other studies showed that when such functions are competed a man-year cost of less than $30,000 in 1999 values can be expected." Escalating to FY 2008 values indicates such work could be accomplished for less than $42,000 per man year. Accordingly, we have reduced the possible savings of $448.4 million by $152.5 million annually in order to pay for contracting out the ship's force work package. That estimate assumes that a number of workers (about 3,600) equivalent to the total number of the E-1 through E-4 personnel removed from all 24 ships during long-term overhaul may be needed to: tile decks; paint compartments; remove dead-ended cables; repair locks, hinges, and door closing mechanism; upgrade bunks and lockers; lag pipes, bulkheads, and ventilation ducting; clean and preserve tanks and voids; and clean ventilation ducting. We anticipate these personnel will also be involved in disposal of hazardous materials.

We have left most of the senior petty officers on the ships to perform the more technical repairs, such as repairing valves and overhauling forklift vehicles, aircraft towing vehicles, and other yellow and white gear. They also would supervise the juniors[11] that remain and

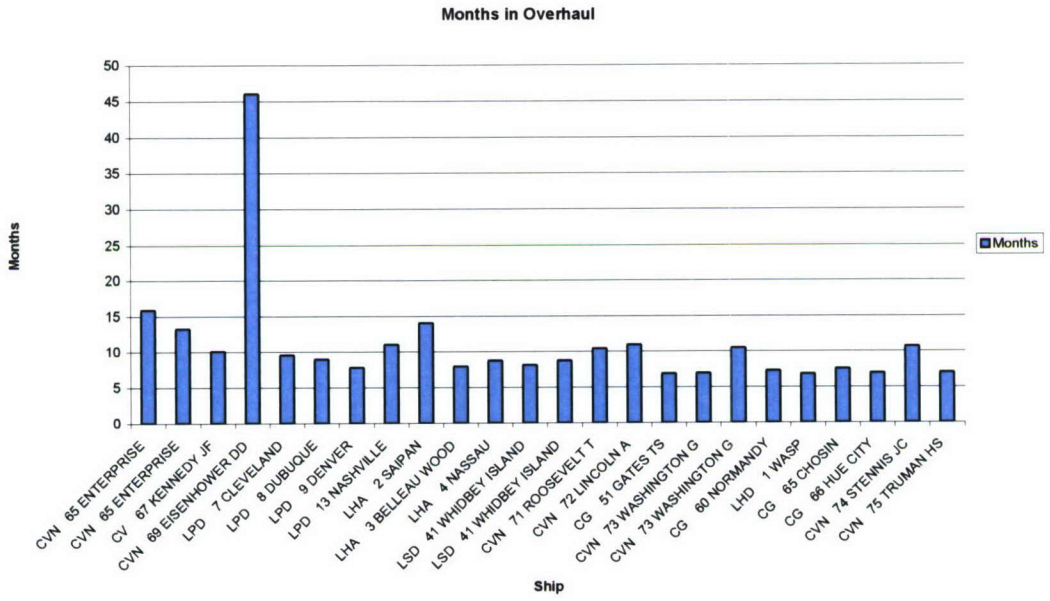
11. Junior petty officers and none rated personnel.

coordinate with the supervisors of the workers performing the ship's force work package tasks.

Overhauls examined

We have examined 24 of the Navy surface ship overhauls accomplished in the last 5-year period. Each has exceeded 7 months in duration, with one, the refueling complex overhaul of USS *Eisenhower* (CVN-69) extending to 46 months duration, almost 4 years. Figure 1 shows the length of time each ship was in the shipyard. The ships are shown in the sequence that the overhauls occurred.

Figure 1. Duration of actual overhauls examined



Post overhaul readiness

In the earlier work [20], there was a concern that reducing the size of a crew while ships are in maintenance will have an adverse effect on readiness later when the ship is in service. In that report we document the record from the early 1980s and found that carriers whose manning was reduced did indeed experience readiness problems

immediately after the overhauls. We also discovered that such problems were always resolved before the start of the next deployment.

In the 1980s, most of the conventional-powered carriers underwent Service Life Extension Periods (SLEP) at the Naval Shipyard in Philadelphia. The ships were not decommissioned during these overhauls, but the crews were reduced substantially.

After the overhauls it took longer than usual to reman the carriers, in part because the recrewing came at the same time the Navy was expanding to 600 ships, with an all-volunteer force. In the short term, the readiness of these carriers, in terms of numbers of mission degrading CASREPs, was affected.

This suggests that great care and managerial attention is needed to assure the ships are promptly remanned with the right numbers of appropriate skilled and experienced personnel, long before the overhaul is completed. We believe this is possible as long as the reporting sailors are not diverted to performing the ship's force work package, and they are allowed to concentrate on getting their ship ready for sea.

Table 8. Decrewing: savings, description, and risks

Annual savings	Description	Risks
$280M	Partial decrewing of surface ships during long-term (more than seven months) overhauls and contracting out the selected jobs in the ship's force work package.	Minimal to moderate: Readiness problems have been reported immediately after the overhaul, but resolved before the start of next deployment. Remanning must be carefully managed.

Sea-shore ratio

Reference [21] notes that the sea-shore ratio had declined from around 1.0 in the 1980s to about 0.8 by 2005 for enlisted personnel, and from 0.5 to 0.4 over the same time period for officers.

The study cautions that we need to understand the structural reasons underlying this change before making any policy recommendations. However, the potential savings from returning to the higher sea-shore ratios of the 1980s are substantial. Holding constant the projected sea billets, returning to the sea-shore ratio of the 1980s means it is possible to reduce shore-based endstrength by 20 percent. Future research may help us understand the sources of the shift in sea-shore ratios and whether there are any savings to be had from reversing the trend.

Assigning pilots more intensively to flying billets

Reference [22] illustrates the potential savings the Navy can realize from reducing the number of shore-based pilot billets. The Navy has approximately two or three pilots per aircraft, a ratio driven to a considerable extent by the Navy's rotation and assignment policies. This means the Navy must train 700 new pilots per year, at a total cost between $1 billion and $1.5 billion. This works out to about $500,000 in training costs per pilot. Even if we assume that only 30 percent of the training costs are variable ($300 million), then a 10 percent cut in accessions would lead to a $30 million annual savings.

A recent CNA study considers both undergraduate pilot training and Fleet Replacement Squadron costs and has estimated that increasing aviators' first sea squadron tour of duty from 3 to 5 years would reduce the required aviator inventory by 4,000 billets and thereby save $490 million[23]. The savings result from more intensive assignment of aviators to sea squadron billets during their first 7 to 10 years of service. The sea squadron total man-years requirement can be filled with fewer personnel if each spends more time in a sea squadron.

According to [23], required pilot accessions would fall from 972 currently to 667 under an alternative. The savings includes $175 million from undergraduate flight training (305 students at $591,000 per student), and $296 million in Fleet Replacement Squadron savings (due to 36,000 fewer flight hours). Per capita training costs used in this study come from Taxpayers Per Capita Cost to Train (TAECARS). Note that these are average costs and therefore include

many of the fixed costs of pilot training, so these figures may overestimate potential savings.

Additionally, there is some evidence that the longer tours would improve readiness, as cited in [10].

Potential risks

Increasing the proportion of flying billet duty (or at-sea flying billet duty) in a pilot's career may have negative retention or attrition effects, as pilots may have to spend more time away from home. Additionally, continuation to higher ranks will have to be higher than current rates to fill all legislatively controlled billets. This initiative will also require a substantial aviation bonus, which would reduce the estimated savings reported in the study. The study [23] notes that the Navy will save money on net if the aviation bonus is less than $1.44 million.

Table 9. Assigning pilots more intensively to flying billets: savings, description, and risks

Annual savings	Description	Risks
$490 million	Extend aviators' at sea flying billet tours, reduce required accessions, training costs	Moderate: May require substantial increase in aviation bonus; includes some fixed costs of training

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Personnel compensation

Much of the compensation provided to Navy military and civilians is controlled outside of the Navy. Nevertheless, it is useful to highlight some areas in which savings might be realized.

Reference [24] examines the costs (paying a more senior force) and benefits (less training and recruitment, higher readiness) of retention, and thus develops rating-specific optimal reenlistment goals for the Navy. The authors estimate that most enlisted personnel are in ratings for which the costs of reenlistment exceed the benefits. In other words, they conclude that the cost-effective level of reenlistment is lower than current goals. Adjusting to the optimal reenlistment rates could save the Navy $15 million to $75 million.[12] The authors caution that the Navy should not make drastic cuts to reenlistment bonuses. Advocating increases in basic pay lower than those in recent years, without decimating the selective reenlistment bonus (SRB) budget, is a more cost-effective and flexible approach to lowering reenlistment.

Table 10. Adjusting to optimal reenlistment rates: savings, description, and risks

Annual savings	Description	Risks
$15-75 million	Move toward cost-effective rating-specific reenlistment rates by adjusting basic pay	Minimal: Calls for an average reenlistment reduction of just 4 percentage points

12. The range is generated by varying the assumption made about whether the marginal reenlistment response to additional compensation varies by rating.

Retirement

An earlier paper [25] estimates that converting to an old-age pension coupled with up front active pay increases would save about 4.2 percent of the system cost (total lifecycle basic pay plus retired pay for a cohort in steady state) while producing the same average experience level. This would amount to about $780 million in savings for DON. The savings stem from reducing the share of compensation that is deferred, together with the assumption that retention decision makers have a discount rate higher than the rate at which the government can borrow. However, [26] considers several alternatives that produce the same experience *distribution* as under the current system and finds little difference in costs.

One important qualification for this initiative is that since DON does not solely influence the military retirement system, any modification to policies would require actions by other parties as well.

Table 11. Reforming military retirement pay: savings, description, and risks

Annual savings	Description	Risks
Up to $780 million	Reform retirement pay to an old-age pension coupled with compensating increases in basic pay (savings result in long run by reducing the present value cost of compensation required to retain the same force)	Moderate: Not fully controlled by DON. Other constraints in manpower system may make potential savings substantially smaller.

Non-quantifiable compensation initiatives

There are many other ways the Navy might be able to make its compensation system more cost-effective. The potential savings from any one of these initiatives individually is likely to be small and/or difficult to measure, but when taken together, the savings might be substantial. Reference [27] argues that the force of the future should be oval rather than pyramid. The paper calls for an end to cliff-vesting retirement (becoming eligible for benefits at 20 years of service) and suggests that the Navy requires lateral entry, pay tied to skill and

experience rather than rank, and a two-part retirement plan that includes voluntary separation pay.

Reference [28] suggests that incentive pays like voluntary separation should be narrowly targeted to reduce the amounts paid to those who elect the voluntary pay but would have left Navy anyway without it.

Reference [22] recommends relaxing the endstrength constraint, retaining a manpower budget constraint instead. Such a policy change would result in savings due to a more efficient personnel mix and better timing of personnel moves and promotions.

In [22], the authors also suggest allowing more choice in rotation. They note that military spouses have lower income when rotation is more frequent. Finally, they recommend an increased use of pay for performance.

Reference [29] recommends generally increased flexibility in the way the Navy compensates its personnel.

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Ship issues

The initiatives for ships consider two long-standing questions.

One question is whether the amount of presence provided by surface ships can be increased. The traditional presence is about 4.5 months out of a 24-month cycle. This works out to the Navy's buying and operating more than five ships for each one forward. How can this ratio of 5 to 1 be reduced and what savings would result? Recent studies of crew rotation provide the answers to these questions.

A second question is whether it is possible to reduce costs for ship maintenance. A number of recent changes should provide savings, such as conditional maintenance, the addition of sensors to help decide what maintenance is necessary, and the lengthening of the time between major maintenance availabilities. These would seem to justify a downward trend in ship maintenance. The instructions describing notional maintenance cycles imply a downward trend; the question is whether this trend is evident in the budgets for maintenance.

The total potential savings of the two initiatives discussed here total about $1.3 billion annually.

Crew rotation

Recent literature suggests that crew rotation can lower the ratio of total ships to ships forward. Reference [30] builds on this literature and estimates savings for the Littoral Combat Ship (LCS). These savings are already built into the LCS budget and so are not counted for the present study. Further savings would result if rotational crewing were extended to the Aegis surface combatants (CGs and DDGs).

The potential savings for the Littoral Combat Ship (LCS) are shown in table 12. The savings are derived by comparing the traditional

deployment with a deployment involving crew rotation, 4/3/1, which denotes 4 crews, 3 hulls generating one ship forward. We have added a column to show the savings that could result from applying the rotation scheme to surface combatants. We have multiplied the savings for the LCS by 6 to account for the fact that there are currently about twice as many surface combatants as there are planned LCS for 8 units of presence (100 surface combatants vice about 50 LCSs) and that surface combatants have manpower and acquisition costs at least three times those planned for LCS.

Table 12. Estimated savings from crew rotation

Savings from crew rotation: LCS hulls and costs ($M05)								
1 unit of presence			8 units of presence					Aegis ship savings
	Trad	4/3/1		Trad	4/3/1	Savings		
Hulls	6.1	3.8	Hulls	49.0	30.2	18.8		38
Cost per pres	$106	$60	Cost	$848	$480	$368	(100%)	$2,208
Cost no proc	$45	$31	Cost no proc	$360	$248	$112	(30%)	$672
			Cost proc	$488	$232	$256	(70%)	$1,536

Whereas crew rotation might postpone new acquisition or modernization of surface combatants, the surest savings would be those excluding procurement, about $672 million per year.

Ship maintenance

OPNAV Note 4700 is issued each year, specifying the norms for ship maintenance. Reference [31] quantifies trends in these norms from FY 2002 to FY 2005. Over all ship classes taken together, man days of maintenance (including continuous maintenance) declined by about 16 percent over this period. Time out of service also declined. Costs and savings are calculated including and excluding procurement.

The total budget for ship maintenance has been going up since FY 2002. Though the budget declines in the outyears, it does not meet the FY 2002 actuals, corrected for changes in the norms. This suggests that the changes in the norms may not have entered the budgeting process. If that is the case, since manpower is about 79 percent

of maintenance costs, there could be savings in maintenance of about 12.6 percent. Maintenance for FY 2007 is about $3.68 billion and for FY 2002 is about $3.5 billion, both in 2005 dollars. If maintenance costs for FY 2007 were 12.6 percent below the FY 2002 value, they would be about $3.05 billion, or a savings from budgeted FY 2007 of about $0.6 billion.

While this analysis is clearly simplistic, it is important to check how the maintenance budget takes account of the trends toward more efficient maintenance summarized in the norms.

Table 13. Ship initiatives: savings, description, and risks

Annual savings	Description	Risks
$672 million	Apply crew rotation to Aegis cruisers and destroyers	Minimal: Effect on retention should be monitored
$600 million	Use changes in depot maintenance norms to benchmark actual maintenance budgets	Moderate: Changes in maintenance may be for reasons not captured by the norms.

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Aviation issues

The aviation-related initiatives deal with the stock of spare parts for the aircraft, the management of aircraft wear, and the reduction of the OPNAV minima on flight hours for aircraft.

Costs for the stock of spare parts (AVCAL and SHORECAL)[13] are about $1 billion per year. These are the costs of buying spare parts for new aircraft, changes in aircraft systems, and changes in the parts themselves. Two initiatives relate to this stock. First, cutting the resupply time for these stocks will result in savings. Second, if operational plans always involve carriers operating together, the AVCALs for the carrier airwings can be reduced without reducing wartime readiness.

Aircraft procurement is roughly $5.9 billion per year over the period FY 2005 to FY 2007. This covers replacing aircraft that wear out with new aircraft. Reducing the rate of wear would reduce the rate of procurement.

The budget for aircraft missions and other aircraft operations is about $4 billion per year. This budget includes three different categories of flight hours: those required to achieve readiness for surge and deployment; those required for operations; and those that contribute to neither of the first two categories but are required by the minima place by OPNAV instructions. If these flight hours were reduced, there would be savings in operating costs and in procurement.

The aviation initiatives, taken together, account for about $700 million.

13. Aviation Consolidated Allowance List and Shore Site Consolidated Allowance List.

Reducing resupply time for stocks of spare parts

A recent study [32] developed a small model relating the parameters of retail inventories and readiness. From running a number of examples with this model it appears that if it were possible to reduce by 50 percent the planned resupply time for the AVCALs and SHORECALs, the retail inventory could be cut at least 20 percent without reducing readiness. This would involve a reduction in resupply time from about 20 days to about 10 days.

Since purchases of retail inventories are about $1billion per year, a 20-percent reduction would save about $200 million per year.

Sharing AVCALs

Under the Fleet Response Plan, a number of carrier airwings will be capable of surging on short notice. If this surge will be in support of other carriers in the same operating area, the AVCALs can be shared, reducing the total requirement. Reference [32] gives a variety of examples in which two airwings from aircraft carriers operating together can generate the same readiness with smaller AVCALs than if they were operating separately. The examples all involve savings of 12 percent or more.

The AVCAL for a carrier has a value of about $100 million [33] or about $1 billion for ten airwings. If about 10 percent of the AVCAL is replaced each year and savings are about 12 percent, the annual savings would be about $1 billion * 10 percent * 12 percent = $12 million.

Note that the feasibility of this initiative depends critically on being sure that surging carriers, in time of war, will be supporting and collocated with other carriers.

Managing aircraft wear

Reference [34] notes that making two changes in the management of fatigue life expended (FLE) for the FA-18 could save about 6 percent fatigue life. These changes are (1) shifting 50 percent of air-to-air

training hours to attack, and (2) restricting transport activities to involve simpler forms of flying. The authors estimate that the first change would reduce fatigue expenditure by about 5 percent. The second change involves a change in the severity of flying comparable to the first change applying to about 4 percent of total flight hours vice 17.5 percent for the first change. Thus, we assume the effect is about 4 percent/17.5 percent * 5 percent = 1 percent. The two changes together thus reduce fatigue life expended by slightly under 6 percent, about 5.8 percent.

This 5.8 percent needs to be adjusted to take account of savings that have already been taken. Our examination of data on the composition of training flights suggests that the first change above has already been started, that air-to-air flights have been reduced by about half the amount considered above. Thus, about half of the 4.8 percent has already been taken, leaving about 2.4 percent, or, including the second change, about 3.4 percent.

These changes reduce the present value of future procurement by about 3.4 percent. Using formulas in [35] this is the equivalent of buying 3.4 percent fewer aircraft. If these changes were applied to average combat aircraft procurement in FY 2005 to FY 2007 of about $5.9 billion in 2005 constant dollars, it comes to about $200 million annual savings.

Though air-to-air is rare in combat, training for it consumes 36 percent of flight hours. Nevertheless, there could be substantial risk in cutting those flight hours too much. The extra training might be justified by the difficulty of the mission. As a hedge, some pilots could specialize in this.

Reducing flight hours early in the training cycle

Reference [35] also notes that there are some flight hours early in the airwing workup cycle that, following the OPNAV Flight Hours Readiness Model, do not contribute to readiness in the sense of surge. Based on data for the FA-18C, these account for about 18 percent of the total flight hour costs.

If these flight hours could be reduced by 20 percent, the savings would be about 3.6 percent = 18 percent * 20 percent. Applying this 3.6 percent reduction to an operations budget of about $4 billion in FY 2005 (mission and other flight operations 1A1A) yields a possible savings of about $144 million. Savings related to reducing fatigue life expended would be equal or greater, bringing the total savings up to about $300 million.

These changes would not come without a substantial risk. The flight hours may be in place for "safety of flight." They may also contribute to training and readiness in a way not revealed in current models. CNA has an ongoing program of study on these two topics. Results so far suggest flight hours have an effect on safety of flight and that training early in the workup cycle does have an impact on operational capability. These results are not yet at the point of producing equations for programming, but when they reach this point, they should be used to modify the Flight Hour Readiness Model and calculations such as those presented in this section. In consequence, we categorize the risks here as being moderate to high.

Table 14. Aviation initiatives: savings, description, and risks

Annual savings	Description	Risks
$200 million	Reducing resupply time for AVCALs and SHORECALs	Moderate: Possible unknown costs of making these reductions
$12 million	Sharing AVCALs among carriers deployed in time of war	Moderate to high: Advance notice is required for carriers to surge together, otherwise readiness would be greatly reduced by the reduction in the AVCAL.
$200 million	Managing fatigue life expended. Includes shifting training from air-to-air to strike.	Moderate: Air-to-air is rare in combat, but may be a capability that should be protected
$144 million in operations, about $300 million total.	Reducing flight hours early in the training cycle	Moderate to high: May adversely effect training or safety of flight.

T&E savings

In 2004, CNO Clark set a goal of reducing test and evaluation (T&E) costs by 20 percent. In that same year the Commander Operational Test and Evaluation Force (COTF), with support from the Assistant Secretary of the Navy for Research, Development and Acquisition, and the systems commands, led an effort to streamline the T&E process. Six working groups were established with the goal of developing recommendations to reduce T&E costs. The working groups are listed in table 15.

Table 15. T&E working groups

Working group	Chair
Risk Management	CDR James Schmidt
Test Planning & Execution (TPE)	Jeff Bobrow
Requirements	Rich Gilpin
Modeling & Simulation (M&S)	Dr. Charles Hutchings
Policy	CDR Bryan Herdlick
Resource Cost	Ramona Franklin

To support the overall effort, the Deputy Assistant Secretary of the Navy for RDT&E asked CNA to assist the Resource Cost working group to assess the impact of the recommendations developed by the working groups. CNA was assigned two tasks. First, a data call was developed and sent to 26 Navy managers of major acquisition programs, as detailed in table 16. The purpose of the data call was to determine how much the programs spent on T&E from FY 2000 to FY 2004, and to use the data to examine trends in T&E spending. Eighteen of the original 26 Navy programs responded to the data call.

Table 16. Navy programs

Organization	ACAT	Type	Program
NAVAIR	IC	Platform	F/A-18 E/F
NAVAIR	II	Weapon	AIM-9X
NAVAIR	IC	Sensor	ATFLIR
NAVAIR	IC	Weapon	TACTOM
NAVAIR	ID	Platform	SH-60R/MH-60R
NAVSEA	IC	Platform	LPD 17
NAVSEA	IC	Platform	ASDS
NAVSEA	III	Platform	DDG-51
NAVSEA	IA	Sensor	A-RCI
NAVSEA	III	Platform	Seawolf
NAVSEA	IVT	Weapon	MK 48
NAVSEA	III	Network	AN/BYG-1
NAVSEA	AAP	Sensor	TB29A
NAVSEA	II	Sensor	Underwater Imaging System
NAVSEA	IID	Weapon	ESSM
NAVSEA	II	Network	CEC
NAVSEA	II	Network	QRCC/SSDS MK1 and MK2
NAVSEA	II	Sensor	SEWIP
NAVSEA	IAC	Sensor	SPY-1D(V)
SPAWAR	IVT	Network	NTCSS
SPAWAR	IC	Network	TESS/NITES 2000
SPAWAR	IC	Network	MIDS-LVT
SPAWAR	III	Network	DMR
SPAWAR	IVT	Network	BFEM 66
SPAWAR	IAM	Network	DMS
DPRM	Special interest	Network	NMCI

CNA was also asked to develop a methodology to cost the recommendations developed by the working groups. The complete list of recommendations is listed in table 17.

Table 17. Working group recommendations

Working Group	Recommendation
TPE	**Provide full support of the Enterprise T&E Task Force as chartered by the Corporate Business Council with the goal of better coordination of improving coordination and planning of T&E.**
TPE	Develop an effective and efficient model that includes an integrated T&E strategy for use in acquiring Joint Interoperable Net-Centric FoS and SoS while simultaneously leveraging public-private ventures.
TPE	Clearly and explicitly reflect the symbiotic relationship between T&E and SE in all Defense Acquisition University (DAU) and SYSCOM training.
TPE	As part of the CNO's Human Capital Strategy under Task Force Total Force, and in recognition that T&E is an engineering specialty, develop a progressive T&E career path with incentives comparable to those associated with other engineering disciplines.
TPE	Institute a rigorous and consistent SE risk management training and implementation strategy throughout the Navy.
TPE	**Perform robust testing earlier in the development cycle to mitigate the risk of late discovered deficiencies.**
TPE	Establish new Navy variable T&E policy and guidance that corresponds to differing factors, such as ACAT level or system complexity.
TPE	Develop a combination of methodologies for reducing the quantity of tests/test articles while maintaining confidence levels for systems under evaluation.
TPE	Develop procedures for FoS/SoS testing that increases the visibility of T&E requirements among programs and optimizes the interconnection of existing naval and DOD facilities for accomplishing T&E on complex systems.
TPE	Develop process/strategy/philosophy to conduct integrated CT/DT/OT, including using the T&E IPT to coordinate DT (including certifications) and OT events and develop and execute an integrated test plan.
Requirements	Initiate a study to determine how best to align JCIDS with the budget process.
Requirements	**Improve the process for requirements generation and refinement of existing requirements/capabilities to improve 'testability.'**

Table 17. Working group recommendations (continued)

Working Group	Recommendation
M&S	**Designate lead programs in each SYSCOM to push the envelope on use of M&S, with support from the appropriate SE technical authority and T&E organizations.**
M&S	Designate an M&S technical authority within each SYSCOM.
Policy	Address a notable shortfall, specific guidance on the definition, purpose, planning, management, and conduct of integrated testing be incorporated into the DON Acquisition and Capabilities Guidebook.
Policy	Clarify the role and purpose of T&E accordingly in all policy documents and guidebooks, with attention to ensuring consistency across all documents.
Policy	In addition to this over-arching recommendation, 15 minor, specific areas of concern regarding T&E policy were also identified. In order to ensure that these issues are addressed, it is recommended that the findings, observations, and recommendations from this report be presented during upcoming reviews and updates to T&E policy documents and guidebooks.
Policy	Improve compliance with T&E policy and the use of best practices and lessons learned.
Resource Cost	Ensure the consolidated Navy Enterprise Resource Planning (ERP) system meets the activity management needs of the T&E Enterprise.
Resource Cost	Focus on T&E within the SE process as a high priority target for lean six sigma process improvement.
Resource Cost	Review the potential for T&E infrastructure cost reductions following completion of BRAC 2005.

Many of these recommendations were too vague and did not lend themselves to quantitative analysis. As a consequence, CNA only estimated costs of four recommendations.[14]

Three CNA reports were published [36, 37, 38], none of which contained a comprehensive estimate of T&E savings that would accrue if all working group recommendations were implemented. Recall that it was former CNO Clark's goal to reduce T&E savings by 20 percent.

14. These recommendations appear in bold typeface in table 17.

It was the consensus of the working group principals, however, that achieving 20 percent savings in T&E was unlikely, but that 10 percent savings was reasonable.

In order to estimate potential T&E savings, FY 2006 R-3 program reports for research, development, test and evaluation (RDT&E) budget accounts 6.5 (System Development and Demonstration) and 6.6 (RDT&E Management Support) were examined to determine how much Navy programs spent on T&E.[15] A total of 60 programs were examined, 46 of which contained T&E budget data as detailed in table 18. Total FY 2006 expenditures were $833.2 million.[16] Assuming 10 percent T&E savings can be realized as a result of implementing the working group recommendations, then FY 2006 T&E spending implies savings of $83.3 million. Savings in future years will depend on actual T&E expenditures.[17]

Table 18. Programs with T&E

Budget activity	PE Code	Program
BA-5	0304785N	Tactical Cryptologic Systems
BA-5	0604212N	Other Helo Development
BA-5	0604214N	AV-8B Aircraft - Eng Dev
BA-5	0604215N	Standards Development
BA-5	0604216N	Multi-Mission Helo Upgrade Dev
BA-5	0604218N	Air/Ocean Equip Engineering
BA-5	0604221N	P-3 Modernization
BA-5	0604230N	Warfare Support System

15. The budget data may be found at http://www.finance.hq.navy.mil/fmb/07pres/rdten/RDTEN_ba_5_book.pdf and http://www.finance.hq.navy.mil/fmb/07pres/rdten/RDTEN_ba_6_book.pdf

16. This amount includes $369.4 million for major T&E investment, test and evaluation support, and operational test and evaluation capability.

17. Not all T&E is captured in table 18. Some T&E, such as ship-shock testing is funded by the respective SCN account. But the data reported above should account for the majority of T&E expenditures in FY 2006.

Table 18. Programs with T&E (continued)

Budget activity	PE Code	Program
BA-5	0604231N	Tactical Command System
BA-5	0604234N	Advanced Hawkeye (E2C)
BA-5	0604245N	H-1 Upgrades
BA-5	0604261N	Acoustic Search Sensors
BA-5	0604262N	V-22A
BA-5	0604269N	EA-18
BA-5	0604270N	Electronic Warfare Development
BA-5	0604273N	VHXX Executive Helo Dev
BA-5	0604280N	Joint Tactical Radio System- Navy
BA-5	0604300N	SC-21 Total Ship System Engineering
BA-5	0604307N	Surface Combatant Combat System Engineering
BA-5	0604311N	LPD-17 Class Systems Integration
BA-5	0604366N	Standard Missile Improvements
BA-5	0604373N	Airborne MCM
BA-5	0604503N	SSN-688 and Trident Modernization
BA-5	0604504N	Air Control
BA-5	0604512N	Shipboard Aviation Systems
BA-5	0604518N	Combat Information Center Conversion
BA-5	0604558N	New Design SSN
BA-5	0604561N	SSN-21 Developments
BA-5	0604562N	Submarine Tactical Warfare System
BA-5	0604567N	Ship Contract Design/ Live Fire T&E
BA-5	0604610N	Lightweight Torpedo Development
BA-5	0604721N	Battle Group Passive Horizon Extension System
BA-5	0604727N	Joint Standoff Weapon Systems
BA-5	0604755N	Ship Self Defense (Detect & Control)
BA-5	0604756N	Ship Self Defense (Engage: Hard Kill)
BA-5	0604757N	Ship Self Defense (Engage: Soft Kill/EW)
BA-5	0604777N	Navigation/ID System
BA-5	0604784N	Distributed Surveillance System
BA-5	0604800N	Joint Strike Fighter (JSF)
BA-5	0605013M	Information Technology Development
BA-5	0605013N	Information Technology Development
BA-5	0605172N	Multinational Information Sharing (MNIS)
BA-5	0605500N	Multi-mission Maritime Aircraft (MMA)
BA-6	0604759N	Major T&E Investment
BA-6	0605864N	Test and Evaluation Support
BA-6	0605865N	Operational Test and Evaluation Capability

Table 19. T&E savings, description, and risks

Annual savings	Description	Risks
$83M for FY 2006 and variable thereafter	Implement T&E savings recommendations	Moderate: Recommendations will not be fully implemented. Even if all recommendations are implemented, realized savings may be less than expected.

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Reducing electricity cost

The study by Ackerman and Shaw [39] recommends that the Navy should meter its largest energy users. In doing so, the Navy could achieve annual savings of $8 million by metering 60 percent of total square footage and $10 million by metering 80 percent of total square footage. These savings estimates are conservative given the large costs of installing meters assumed in the study.[18] Savings will also be greater if electricity prices vary with time of use, i.e., peak load pricing. Reference [39] focused on Navy facilities in San Diego that are already metered. The authors found that, on average, electricity usage and total costs declined 5 and 9 percent. Benefits of metering electric facilities include identifying wasteful electricity usage and reducing power demand. When [39] was written in 2003, Congress was considering legislation requiring electric metering of all federal facilities. The Congressional bill became The Energy Policy Act of 2005, and was signed into law by President Bush on August 8, 2005. There is no current information on the amount of Navy facility square footage that has been metered to date, but given that The Energy Policy Act of 2005 was recently enacted, it seems that the majority of savings from metering Navy facilities are still unrealized.

Table 20. Electricity metering savings, description, and risks

Annual savings	Description	Risks
$10 million	Install electricity meters at Navy facilities	Minimal: Federal legislation recently passed.

18. "The Naval Facilities Engineering Command estimates that it costs $5,000 to purchase and install a new meter" [39, p. 2].

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Shipbuilding and aircraft procurement issues

Shipbuilding for the Navy has often been cited as inefficient, and the commercial side of shipbuilding is even worse in terms of efficiency and productivity. The Navy's SCN account budget for FY 2007 is over $8 billion for new construction. With improvements in shipbuilding from best practices and lean manufacturing processes, the Navy could save $430 million or more per year.

Like shipbuilding, aircraft production can benefit from the implementation of lean principles and lean manufacturing. The Navy's APN account for the procurement of new aircraft is budgeted at nearly $8 billion for FY 2007. Assuming that the defense aircraft manufacturers could save 20 percent of this figure and then split the savings equally with the Navy, the Navy could save as much as $797 million per year.

Table 21. Effects of lean manufacturing: savings, description, and risks

Annual savings	Description	Risks
$430M	Applying best practices and lean manufacturing in shipbuilding and sharing the savings with contractors	Moderate: Depends on cost savings share ratio and proper incentives in contracts
Up to $800M	Applying lean practices to defense aircraft industry and sharing the savings with contractors	Moderate: Depends on cost savings share ratio and incentives

Savings from best practices and lean manufacturing in ship building

According to First Marine International [40], in research done on behalf of the Deputy Undersecretary of Defense for Industrial Policy, implementation of lean manufacturing principles and best practices

can save shipbuilders up to $860 million per year. Assuming that the government shares these cost reductions equally with contractors, the Navy could save $430 million per year.

These initiatives, proposed by First Marine International, include: increasing the use of best practices in shipbuilding, making more effective use of technology employed in shipbuilding, optimizing ship designs to reduce work content, and reducing the customer factor (government oversight and regulations). The cost savings calculations have been loosely calculated, but do give an accurate picture of the type of improvement that could be expected at the six biggest U.S. shipyards.

Conversations with subject matter experts and examination of other research indicate that projected savings may be very conservative due to the way contracts are currently structured for Navy shipbuilding.[19] The shipyards the Navy contracts with to build its ships are inefficient (compared to competitive international commercial shipyards), antiquated, and are rewarded for using more labor to build a ship.[20] One subject matter expert said that the Japanese redesigned the construction of the DDG-51 class for easier assembly and construction and that the US shipyards and Navy could learn from their practices.

With proper incentives provided in a contract, the Navy and shipyards could achieve these conservative estimates of savings.[21] The total amount saved for the Navy will vary based on the share ratio. Contracting is well within the Navy's control. However, some of the issues

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19. Subject matter experts include a CNA research analyst who has authored many papers on shipbuilding, shipyard efficiency, and ship manning; and other research includes various GAO reports [41, 42, 43] that investigated cost growth in shipbuilding and the use of incentive and award fees in contracting.

20. A Bureau of Industry and Security study [44] states, "Current U.S. DOD procurement policies do not adequately reward innovation in military ship construction practices, thereby indirectly encouraging shipbuilders to maximize labor hours."

21. A discussion of proper incentives is beyond the scope of this research and we refer the reader to [41].

raised by First Marine, such as government oversight and regulations, may be out of the scope of the Navy's control.

Savings from lean principles in aircraft production

Similar to the shipbuilding industry, the defense aircraft industry can potentially see large cost savings from full implementation of lean practices. Although a firm dollar amount of annual savings is not available, a RAND study [45] estimates that savings up to 20 percent are possible (using total aircraft historical cost) if lean principles are implemented throughout the entire organization. If we assume that 20 percent is the ceiling on savings and use the Navy's FY 2007 estimate for aircraft procurement, the savings are about $1.6 billion.

Based on [45] and other studies from MIT's Lean Aerospace Initiative [46, 47, 48], the amount of lean implementation in defense aerospace is small. There is substantial room for improvement and some early reports show cost savings based on pilot programs. However, [45] cautions that these results should not be generalized to an entire program for fear of double counting savings.

The Navy should not expect a savings of 20 percent across the board for aircraft procurement, so we offer that as a ceiling. In reality, the Navy may have to share these cost savings with industry in order for lean principles to be fully implemented. For example, if the Navy were to share these cost savings equally with industry, the Navy could save about $800 million per year (for the 2007 APN estimate).[22]

As in the case with shipbuilding, contracting for aircraft production is well within the Navy's control and providing the proper incentives for lean manufacturing is essentially a contracting issue. Similarly, reducing government oversight and regulations for aircraft production may not be under the Navy's control. This may impair contractors' abilities to fully implement lean principles throughout their enterprise. As such, savings may be less than the projected ceiling of $800 million per year.

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22. Fixed price incentive contracts contain share ratios where the government and contractor share both cost under-runs and cost over-runs. A 50-50 share ratio appears to be common now [49].

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Other potential for savings

BRAC

On September 8, 2005, the Base Realignment and Closure (BRAC) Commission submitted its final report with recommendations to the President. Nineteen of the BRAC Commission's final recommendations directly affected Navy facilities. These recommendations are listed in table 22.

Table 22. BRAC recommendations affecting DON

Recommendation	City	State	Payback period (years)	20-year NPV ($M)
Marine Corps Logistics Base	Barstow	CA	Immediate	(230.6)
Naval Weapons Station Seal Beach Det	Concord	CA	1	(199.7)
Submarine Base	New London	CT	1	(55.5)
Officer Training Command	Pensacola	FL	6	(7.6)
Naval Air Station	Atlanta	GA	Immediate	(446.0)
Navy Supply Corps School	Athens	GA	18	1.4
Naval Support Activity	New Orleans	LA	Immediate	(387.7)
Naval Air Station	Brunswick	ME	2	(797.9)
Marine Corps Support Activity	Kansas City	MO	Immediate	(67.0)
Naval Station	Pascagoula	MS	Immediate	(665.7)
Naval Air Station Joint Reserve Base	Willow Grove	PA	2	(757.8)
Naval Station	Newport	RI	13	(2.1)
Naval Air Station	Ingleside & Corpus Christi	TX	3	(614.2)
Engineering Field Division/ Activity	Roll up	N/A	4	(81.8)
Navy and Marine Corps Reserve Centers	Roll up	N/A	6	(76.8)
Navy Recruiting Districts	Roll up	N/A	Immediate	(214.5)
Navy Regions	Roll up	N/A	1	(34.6)

Table 22. BRAC recommendations affecting DON (continued)

Recommendation	City	State	Payback period (years)	20-year NPV ($M)
Navy Reserve Centers	Roll up	N/A	1	(236.6)
Navy Reserve Readiness Commands	Roll up	N/A	Immediate	(91.7)
TOTAL				(4,996.4)

The 20-year net present value of savings from these recommendations totals about $5 billion. But this amount includes savings associated with elimination of military personnel (Milpers) billets. The BRAC Commission believes that these savings will not be realized. Adjusting the savings downward and expressing the figure in annual terms yields potential savings of $105.3 million annually over 20 years. A significant issue is whether these savings have already been earmarked for specific purposes. According to the DOD comptroller, "[t]he distribution of [BRAC] funds across the Department's requirements is managed in the Office of the Under Secretary of Defense (Comptroller) (OUSD(C))." Some of the BRAC savings may remain in the BRAC account to fund things like military construction. In that case, BRAC savings will not be available to fund new procurement.

Table 23. BRAC savings, description, and risks

Annual savings	Description	Risks
Up to $105 million annually over 20 years	Realignment and closure of Navy facilities	High: BRAC savings may already be earmarked for other purposes.

Conclusions and recommendation

In order to achieve the 313-ship battle force, the planned ramp up in the Navy's procurement would require finding savings from other accounts (or what the Secretary of the Navy termed "excesses in operations and maintenance, personnel accounts and other aspects of the Navy budget"). We examined a wide range of initiatives and found that there would be ample opportunities for savings that would allow more money into procurement, substantially improving the Navy's buying power.

The initiatives and ideas we examined, most of which had been identified in previous studies, included:

- Reducing ship manning through Mil-Civ conversion of some functions
- Using more experienced and specialized sailors and longer tours
- Competitive sourcing
- Decrewing during overhauls
- Reducing shore-based pilots
- Adjusting to optimal reenlistment rates
- Reforming military retirement pay
- Applying crew rotation to cruisers and destroyers
- Using changes in depot maintenance norms
- Reducing supply time for AVCALs and SHORECALs
- Sharing AVCALs among carriers
- Managing aircraft fatigue life
- Reducing FH early in training cycle

- Identifying savings in T&E
- Reducing electricity costs
- Applying lean manufacturing to Navy shipbuilding and defense aircraft industry

We reviewed prior studies on these subjects, assessed the ideas, and projected the overall savings. Collectively, the total savings from these initiatives add up to between $7 billion and $10 billion. The Navy should have control over implementation of all of these changes, except reforming military retirement pays. Subsequently, the low end of the savings range does not include this one. We assessed the risk associated with each of these initiatives and deemed most to be minimal to moderate in terms of cost uncertainty, effects on readiness, or other effectiveness measures. Nonetheless, tough decisions must be made and cultural and other barriers must be overcome before the Navy can realize the savings.

Some of the individual initiatives, such as competitive sourcing, have been thoroughly researched and partially implemented already. Others have not. We recommend that the latter category of initiatives,[23] the savings figures, and the associated risks be more thoroughly studied before the Navy decides to implement any of them.

23. This category would include: decrewing, reducing shore-based pilots, applying crew rotations to cruisers and destroyers, using changes in depot maintenance norms, reducing supply time for AVCALs and SHORECALs, sharing AVCALs among carriers, managing aircraft fatigue life, reducing FH early in training cycle, savings in T&E, and applying to Navy shipbuilding and defense aircraft industry.

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